

What is claimed is:

1. Method for transporting, chemical-mechanical polishing and drying of workpieces, in particular silicon wafers in a sealed clean room with the following steps:

5 the workpieces are removed by at least one transfer device from a loading and unloading station and transferred onto an intermediate station

10 the workpieces are received by at least one polishing head of a polishing device of the intermediate station, transported to a polishing plate of the polishing device and held under rotation of the polishing head against the rotating polishing plate;

15 after polishing, the workpieces are transported back by the polishing head to the intermediate station, released from the polishing head and cleaned and/or chemically treated in the intermediate station

the cleaned and/or chemically treated workpieces are transported from the intermediate station optionally to a second polishing device or to a washing or drying device and washed and dried therein

20 the washed and dried workpieces are transported back by the transfer device to the loading and unloading station

the polishing head is cleaned before each workpiece is received.
2. Method according to claim 1, characterised in that the workpieces are removed with a first transfer device from a loading and unloading station and placed on a first transfer point, the workpieces being transported by a second transfer device from the transfer point to the intermediate station.

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3. Method according to claim 2, characterised in that the cleaned and dried workpieces are transported back by the first transfer device to the loading and unloading station.
- 5 4. Method according to claims 1, characterised in that the workpieces processed by the first polishing device are transported by means of a second polishing head from the intermediate station to a second polishing device and held against a second polishing plate of the second polishing device and after polishing transported back to the intermediate station.
- 10 5. Method according to claim 1, characterised in that gripper means of the transfer device or the first and second transfer device are cleaned before each workpiece is picked up.
- 15 6. Method according to claim 1, characterised in that the workpieces are chemically treated in the intermediate station.
7. Method according to claim 1, characterised in that the gripper means of the transfer device or the first and second transfer device pick up the workpieces only at their edge.
- 20 8. Method according to claim 1, characterised in that from the temperature variation measured on the surface of the polishing plate and the variation of the load of a drive means for driving the polishing plate a signal is derived for switching off the drive means.
- 25 9. Method according to claim 8, characterised in that the polishing plate is cooled by a liquid and the temperature variation of the difference between the inflow and the outflow of the liquid is taken into consideration when the shutoff signal is derived.
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10. Method according to claim 1, characterised in that the workpieces in the intermediate station are moved from a point for depositing and receiving the polishing head and during the movement are cleaned and/or chemically treated.
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11. Device for the chemical-mechanical polishing of the surface of circular, flat workpieces, in particular semiconductor wafers, with
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- an intermediate station for the workpieces, to which the workpieces to be processed are transported by a transfer device and into which processed workpieces are deposited, before they are unloaded after a cleaning and drying process, the intermediate station comprising:
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- a carrier (34) rotatably mounted about a vertical axis which can be brought into a predetermined position by a rotary drive (48) and at least two horizontal, upwardly exposed loading surfaces (54) on the carrier (34), furthermore with
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- a transfer device (38) with which workpieces can be placed on the loading surface (54) or removed therefrom
 - at least two polishing plates (20a, 20b) comprising polishing stations (30, 31) which are arranged on the circumference of the carrier (34),
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- at least one polishing head (18) for the workpieces (56) for each polishing station, which is moved by means of an adjusting device along a vertical and a horizontal axis to be vertically aligned with a loading surface (54), for receiving and depositing a workpiece (56)
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- and for transporting the workpieces (56) to the associated polishing

station (30, 31) and therefrom, in addition to cooperating with the polishing plate (20a, 20b) of the associated polishing station (30, 31) and

- 5 - a control device for the rotary drive device and the adjusting device.
12. Device according to claim 11, characterised in that a centring device (58, 60) is provided on the carrier (34) for each loading surface (54) which grip onto the circumference of a workpiece (56) on the loading surface (54) with
10 centring means which are actuated by an actuation device, in order to align the workpiece (56) radially to a predetermined vertical axis.
 13. Device according to claim 11, characterised in that a device (74) associated with the carrier (34) for cleaning and/or hydrophilising and/or keeping the
15 upper surface of the workpieces (56) wet on the loading surfaces (54) is provided.
 14. Device according to claim 11, characterised in that four loading surfaces (54) are provided on the carrier (34).
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 15. Device according to claim 11, characterised in that four loading surfaces (54) are provided on the carrier, that linear guides (10a, 10b) are associated with each polishing station (30, 31) for two independently guided carriers (18) and the loading surfaces (54) are arranged such that in a predetermined
25 rotary position of the carrier (34) the vertical axis of a loading surface (54) and the carrier (18) lie in a common vertical plane which extends parallel to the guides (10a, 10b).

16. Device according to claim 11, characterised in that the carrier (34) comprises a central elevation (70) in which nozzles (74) aligned to the loading surfaces (54) are arranged, which are connected to a fluid source.
- 5 17. Device according to claim 16, characterised in that detectors (78) are arranged in the elevation (70) which determine whether a workpiece (56) is arranged on the loading surfaces (54).
- 10 18. Device according to claim 11, characterised in that the carrier (34) is encircled by the side wall (80) of a dripping tub for the entire system which extends below the carrier (34).
- 15 19. Device according to claim 18, characterised in that a dripping tub (82a) is associated with each loading surface (54) and which comprises an outlet to the dripping tub for the entire system.
- 20 20. Device according to claim 11, characterised in that the centring means for each loading surface comprise a plurality of axial movable centring cams (58) arranged spaced apart on a circle with support surfaces for the edge regions of a workpiece (56) and with stop surfaces which can be brought into engagement with the circumference of a workpiece (56) when the centring cams (58) are radially adjusted, an actuation device (60) synchronously radially adjusting stop surfaces in order to align the axis of the workpiece (56) to the predetermined vertical axis.
- 25 21. Device according to claim 11, characterised in that the loading surfaces (54) are concave and comprise bores for the drainage of liquid which collects on the loading surface (54) and/or nozzles for cleaning the rear face of a workpiece (56) on the loading surface (54).

22. Device according to claim 11, characterised in that the loading surfaces (56) are constructed on the upper face of a separate cap-shaped element (52) which is supported by a trunnion-shaped upright support portion (50) of the carrier (34).
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23. Method for the chemical-mechanical polishing of the surface of semiconductor wafers by means of two polishing stations, each comprising a polishing plate, two carriers for each polishing station which independently from one another are moved vertically and horizontally, four loading
- 10 surfaces of which the centre lies on a circle and which can be rotated together about a vertical axis and which are arranged between the polishing stations such that in defined common rotary positions, which are spaced about an angle of 90° or a multitude of 90° , two loading surfaces are respectively aligned with the linear transport path of two carriers belonging
- 15 to a polishing station and in a predetermined rotary position and by means of a loading and unloading device, with which in a predetermined rotary position of the loading surfaces two loading surfaces can be respectively loaded with a workpiece or have a workpiece removed, with the following method steps:
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- a) after loading two loading surfaces with a first and a second workpiece the loading surfaces are rotated about 90° , whereby the workpieces are aligned with the first polishing station and are moved by the carriers of the first polishing station to the polishing plates to
- 25 carry out a first polishing process
- b) after removing the first and second workpiece by the carrier a third and fourth workpiece are deposited on the associated loading surfaces and by rotating the loading surfaces about 90° are aligned with the second polishing station, whereafter the first and second workpiece

are removed by the carriers from the first polishing station and deposited on the facing free loading surfaces

- 5 c) after rotating the loading surfaces about 180° the first and second workpiece are transported by the carriers of the second polishing station and the third and fourth workpiece are transported by the carriers of the first polishing station to the appropriate polishing plate
- 10 d) after finishing the polishing process the workpieces are deposited on associated loading surfaces and the third and fourth workpiece aligned to the second polishing station and the first and second workpiece removed from the loading and unloading device, so that subsequently a loading with a fifth and sixth workpiece can take place.

- 15 24. Method according to claim 23, characterised in that after step c) a fifth and sixth workpiece are deposited on the associated loading surfaces and after rotating about 90° aligned with the second polishing station and are deposited on the facing loading surfaces and after rotating of the loading surfaces about 90° the first and second workpiece are removed and by rotating about a further 90° the free loading surfaces are aligned with the first
- 20 polishing station to receive the third and fourth workpiece and for the subsequent transportation to the second polishing station and for the transportation of the fifth and sixth workpiece to the first polishing station.

- 25 25. Device for transporting, chemical-mechanical polishing and cleaning and drying of workpieces, in particular silicon wafers in a sealed clean room with the following features

a loading and unloading station (102) for the workpieces

at least one transfer device with gripping means for the transportation of the workpieces (112) from the loading and unloading station to an intermediate station (120)

5 a polishing device with at least one polishing plate (130, 132) and at least one polishing head (134, 136, 138, 140), the polishing head comprising means for holding a workpiece (112) and can be adjusted in its height and horizontally between the intermediate station (120) and the polishing plate (134 to 140)

10 means for cleaning and/or chemical treatment of the polishing head and/or the workpiece in the intermediate station (120)

and a washing and drying device (154, 156, 162) for the processed workpieces.

15 26. Device according to claim 11, characterised in that a processing and cleaning station (142 to 148) is associated with the intermediate station (120), and into which the workpieces (112) together with the polishing head can be brought or into which the polishing head can be brought for processing and cleaning purposes.

20 27. Device according to claim 26, characterised in that the processing and cleaning station (142 to 148) is arranged over the intermediate station (120) and the carrier (34).

25 28. Device according to claim 26, characterised in that the processing and cleaning station (142 to 148) comprises a tub (210) which is provided with cleaning nozzles.

30 29. Device according to claim 28, characterised in that the processing and cleaning station (144 to 148) comprises downwardly directed cleaning nozzles (226).

30. Device according to claim 26, characterised in that the processing and cleaning station (144 to 148) comprises cleaning brushes (220) to clean the received workpiece or the polishing head.
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31. Device according to claim 25, characterised in that the polishing head (134) can be exchangably attached to a spindle (184).
32. Device according to claim 25, characterised in that the gripping means for flat, circular workpieces (112) comprise two parallel spaced rigid shafts (234, 232) rotatably mounted in a gripper housing (230) which comprise gripping jaws (238, 236) on the end which can be brought into engagement in a rotary position with an edge of a workpiece (112).
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33. Device according to claim 22, characterised in that between the shafts (232, 234) in the vicinity of the housing (230) gripping jaws (240, 242) are arranged which can be moved laterally.
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34. Device according to claim 25, characterised in that the gripping means (166) comprise a sensor (244) which detects the receipt of a workpiece (112).
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35. Device according to claim 25, characterised in that a dressing device (192) is provided for the polishing plate (130) which comprises a dressing unit which can be moved diametrically over the polishing plate (130).
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36. Device according to claim 35, characterised in that the dressing component produces a high pressure jet.
37. Device according to claim 36, characterised in that the dressing component comprises a rotary driven dressing brush.
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38. Device according to claim 37, characterised in that a tank is provided for keeping the dressing brushes wet, in which the dressing brushes are held cleaned and damp.